Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] What is claimed is:

1.A method for reducing a blocking artifact in a video stream, the method comprising:

calculating an activity value representing local activity around a block boundary between a plurality of adjacent blocks in the video stream;

determining a region mode according to the activity value;

determining a plurality of thresholds; the thresholds taking into account a user defined offset (UDO) allowing the thresholds to be adjusted according to the UDO value; and

filtering a plurality of pixels around the block boundary according to the region mode and the thresholds.

[c2] 2.The method of claim 1, further comprising at least taking into account differences in quantization parameters QPs of the adjacent blocks to determine a first threshold, a third threshold, a fourth threshold, a fifth threshold, a sixth and a seventh threshold.

[c3] 3.The method of claim 2, further comprising calculating the activity value computed as a sum of absolute differ-

ences between pixels V_l around the block boundary as follows:

$$ACTIVITY = \sum_{i=1}^{4} |v_i - v_{i+1}| + \sum_{i=8}^{10} |v_i - v_{i+1}|$$

[c4] 4.The method of claim 2, wherein:
if at least one of the adjacent blocks is an intra-coded block:
if the activity value is greater than a first threshold, determining the region mode to be an active region;
if the activity value is less than the first threshold but greater than a second threshold, determining the region mode to be a smooth region; and
if the activity value is less than the second threshold, determining the region mode to be a dormant region; and
if none of the adjacent blocks are intra-coded blocks:
if the activity value is greater than a third threshold, determining the region mode to be an active region;
if the activity value is less than the third threshold but greater than the second threshold, determining the region mode to be a smooth region; and
if the activity value is less than the second threshold, determining the region mode to be a dormant region.

[c5] 5.The method of claim 4, wherein the second threshold

is fixed at a predetermined value.

[c6] 6.The method of claim 5, wherein the predetermined value is 6.

[c7] 7.The method of claim 2, further comprising:
if at least one of the adjacent blocks is an intra-coded block:
if the region mode is active region,
if a high frequency component c_3 is less than a fourth threshold, filtering the pixels around the block boundary according to the filtering range using a first filter;
if the region mode is smooth region,
if the absolute value of the difference of the pixel values on either side of the block boundary is less than a fifth threshold, filtering the pixels around the block boundary according to the filtering range using a second filter; and
if the region mode is dormant region,
if the absolute value of the difference of the pixel values on either side of the block boundary is less than the fifth threshold, filtering the pixels around the block boundary according to the filtering range using a third filter; and
if none of the adjacent blocks are intra-coded blocks:
if the region mode is active region,
if the high frequency component c_3 is less than a sixth threshold, filtering the pixels around the block boundary according to the filtering range using the first filter;

if the region mode is smooth region,
if the absolute value of the difference of the pixel values on either side of the block boundary is less than a seventh threshold, filtering the pixels around the block boundary according to the filtering range using the second filter; and
if the region mode is dormant region,
if the absolute value of the difference of the pixel values on either side of the block boundary is less than the seventh threshold, filtering the pixels around the block boundary according to the filtering range using the third filter.

[c8] 8.The method of claim 7, wherein the high frequency component c_3 is calculated using pixels v_6, v_7, v_8, v_9 around the block boundary as follows:
$c_3 = (v_6 - v_7 + v_8 - v_9)/2$.

[c9] 9. The method of claim 7, wherein the first filter is a one dimensional filter formed by using a 4-point Hadamard Transform (HT), wherein the high frequency coefficient of the HT is reduced to 0 for frame-coded pictures.

[c10] 10. The method of claim 7, wherein the first filter is a one dimensional filter formed by using a 4-point Hadamard Transform (HT), wherein the high frequency coefficient of the HT is reduced to one half for field-

coded pictures.

[c11] 11.The method of claim 7, wherein the filtered pixels are further refined by adjusting a pixel quantized with a larger QP to have more change in value than a pixel quantized with a smaller QP.

[c12] 12.The method of claim 11, wherein a first weighting value WT1 and a second weighting value WT2 are used for adjusting the filtered pixels and are obtained from a first quantization parameter QP1 of a first adjacent block and a second quantization parameter QP2 of a second adjacent block as follows:

$$WT1 = {QP1}/{QP1+QP2}\ ,\quad WT2 = {QP2}/{QP1+QP2}$$

[c13] 13.The method of claim 7, wherein if quantization parameters (QPs) of the adjacent blocks are the same, the second and third filters are symmetric and used to filter the pixels around the block boundary for smooth and dormant region modes, respectively; and
if the QPs of the adjacent blocks are not the same, the second and third filters are asymmetric and used to filter the pixels around the block boundary for smooth and dormant region modes, respectively.

[c14] 14.The method of claim 13, further comprising:

when the region mode is smooth region and the QPs of the adjacent blocks are the same, filtering the pixels around the block boundary with an N-tap symmetric second filter;

when the region mode is smooth region and the QPs of the adjacent blocks are not the same, filtering the pixels around the block boundary with an M-tap asymmetric second filter;

when the region mode is dormant region and the QPs of the adjacent blocks are the same, filtering the pixels around the block boundary with a K-tap symmetric third filter; and

when the region mode is dormant region and the QPs of the adjacent blocks are not the same, filtering the pixels around the block boundary with an L-tap asymmetric third filter.

[c15] 15.The method of claim 14, wherein:

N=5 and the symmetric second filter is [1 3 8 3 1]/16;

M=5 and the asymmetric second filter is [1 2 8 3 2]/16 and [2 3 8 2 1]/16;

K=5 and the symmetric third filter is [1 2 2 2 1]/8; and

L=5 and the asymmetric third filter is [1 1 2 2 2]/8 and [2 2 2 1 1]/8.

[c16] 16.The method of claim 14, wherein filtering the pixels around the block boundary comprises first filtering the

pixels at the block boundary and next filtering pixels not adjacent to the pixels at the block boundary.

[c17] 17.The method of claim 14, further comprising if the video stream comprises interlaced video, performing an interpolation operation to estimate pixel values in an interlaced field before filtering the pixels around the block boundary.

[c18] 18.The method of claim 14, further comprising determining a filtering range according to block coding types of the adjacent blocks in the video stream, wherein the filtering range specifies a number of pixels to filter around the block boundary.

[c19] 19.The method of claim 18, wherein according to the block coding types of the adjacent blocks in the video stream, the filtering range is determined to be up to eight pixels around the block boundary.

[c20] 20.The method of claim 18, wherein determining the filtering range according to the block coding types of the adjacent blocks in the video stream further comprises:
if at least one of the adjacent blocks is an intra-coded block, determining the filtering range to be up to four pixels around the block boundary; and
if none of the adjacent blocks are intra-coded blocks,

determining the filtering range to be up to eight pixels around the block boundary.

[c21] 21.The method of claim 1, wherein the video stream is an MPEG video stream.